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LIQUID CRYSTAL DISPLAY PANEL AND ITS MANUFACTURING METHOD

[Abstract]

PROBLEM TO BE SOLVED: To enhance the display quality of a liquid crystal display device by eliminating the problem that when a liquid crystal is injected into a liquid crystal display panel, then an opening part for injecting the liquid crystal is sealed, a sealing material enters to a liquid crystal display region to generate display defects.

SOLUTION: A metal film 9 is provided between the liquid crystal display region 8 and the opening part 3 for injecting the liquid crystal on at least one substrate of two substrates opposed to each other of the liquid crystal display panel 10.

[Claim(s)]

[Claim 1] In a liquid crystal panel that is formed by applying an adhesive agent on at least one of two substrates in a frame-shape to surround a liquid crystal display area except for an area corresponding to an opening for injecting liquid crystals and adhering the space of the two substrates disposed opposite to each other with the adhesive agent applied,

the liquid crystal display panel comprising: a metal film located between the opening and the liquid crystal display panel on at least one of the two substrates.

[Claim 2] The liquid crystal display panel as recited in claim 1, wherein the metal film is made of one of materials including aluminum, titanium, chromium and silicon.

[Claim 3] In a method for manufacturing a liquid crystal display panel including: forming a thin film transistor, a gate bus line and a drain bus line on at least one of two substrates; applying an adhesive agent on at least one of two substrates in a frame-shape to surround a liquid crystal display area except for an area corresponding to an opening for injecting liquid crystals; and adhering the space of the two substrates disposed opposite to each other with the adhesive agent applied,

the method for manufacturing the liquid crystal display panel comprising: forming a

metal film between the opening and the liquid crystal display panel on an upper substrate with a same process for forming the gate bus line.

[Title of the Invention]

LIQUID CRYSTAL DISPLAY PANEL AND METHOD FOR MANUFACTURING THE SAME

[Detailed Description of the Invention]

[Field of the Invention]

The present invention relates to a liquid crystal display panel and a method for manufacturing the same and, more particularly, to a liquid crystal display panel, into which liquid crystal is injected in a deep-injection method.

[Description of the Prior Art]

Recently, the liquid crystal display devices have been widely used as display devices for personal computer, televisions, digital cameras, etc., by virtue of the advantages of thin frame, light weight, low-voltage drive, low-power consumption, etc.

In general, the liquid crystal display panel comprised in the liquid crystal display device has two transparent (glass) substrates, into which liquid crystal is injected. One substrate (CF substrate) includes black matrix, color filter, common electrode, alignment film, etc., and the other substrate (TFT substrate) has thin film transistor (hereinafter referred to as TFT), gate bus line, drain bus line, pixel

electrode, alignment film, etc.

One of the methods for injecting liquid crystal between the two substrates is a deep-injection method.

The deep-injection method comprising: applying adhesive agent on one of the substrates in a frame-shape to surround a display area except for an area corresponding to an opening for injecting liquid crystal; distributing spacers of a spherical or cylindrical shape; and adhering the space of the two substrates with the adhesive agent applied. Next, when the opening being soaked in the liquid crystal in vacuum state is returned to the atmospheric pressure, the liquid crystal is introduced between the substrates due to the difference of pressures. Finally, when the opening is sealed by thermo-reinforced or ultraviolet hardening resin (seal material) applied, the liquid crystal display panel is completed.

Fig. 4 illustrates an example of the process for manufacturing the conventional liquid crystal display panel. As shown in Fig. 4A, the seal material 2 is applied on the substrate 1 except for the openings 3. Then, the substrate 1 is cut along with scribe lines X and Y to make one substrate 11. The other substrate 12 having a gate terminal 4 connected to the gate bus line and a drain terminal 5 coupled to the drain bus line is adhered with the substrate 11. Then, after introducing the liquid crystal into the opening 3, the seal material 7 stops the

opening 3 to make the liquid crystal display panel 10 as shown in Fig. 4B.

While the seal material 7 is applied on the opening 3 after injecting the liquid crystal through the opening 3, it is necessary that some quantity of seal material 7 be supplied to the inside of the opening 3 to a certain extent that the seal material 7 doesn't get to the display area so as to seal the opening 3 completely. To that end, after applying the seal material 7 of resin on the opening 3, the opening 3 is left as it is for several seconds or for scores of seconds until the resin gets into the opening 3. Then, the seal material 7 is hardened by irradiating heat or ultraviolet rays.

However, the invasion velocity of the seal material into the liquid crystal display panel 10 is sharply fluctuated by the environmental conditions, such as viscosity of the seal material 7, un-uniformity of the opening's width, temperature, humidity, etc., and by the state of glass surface processed in case of the glass substrate. Besides, as shown in Fig. 3, a sectional enlarged plane view of the opening 3, the seal material 7 invades up to the display area 8, thus causing display errors.

Meanwhile, establishing a restriction bar for preventing the seal material from invading into the liquid crystal display panel in the vicinity of the opening is disclosed by Japanese Patent Laid-Open No. 055333/1990, however, the width of

the opening for injecting liquid crystal is substantially narrowed by the restriction bar, which raises a problem that increases the time for injecting liquid crystal material remarkably.

[Means for Solving the Problem]

To solve the problems described above, a preferred embodiment of the present invention provides, in a liquid crystal panel that is formed by applying adhesive agent on at least one of two substrates in a frame-shape to surround a liquid crystal display area except for an area corresponding to an opening for injecting liquid crystal and adhering the space of the two substrates disposed opposite to each other with the adhesive agent applied, the liquid crystal display panel comprising: a metal film established between the opening and the liquid crystal display panel on at least one of the two substrates, as claimed in claim 1.

Besides, the metal film is made of one of materials including aluminum, titanium, chromium and silicon, as claimed in claim 2.

Moreover, in accordance with another embodiment of the invention, there is provided, in a method for manufacturing liquid crystal display panel including: forming thin film transistor, gate bus line and drain bus line on at least one of two substrates; applying adhesive agent on at least one of two substrates in a frame-shape to surround a liquid crystal display area except for an area corresponding to

an opening for injecting liquid crystal; and adhering the space of the two substrates disposed opposite to each other with the adhesive agent applied, the method for manufacturing liquid crystal display panel comprising: forming a metal film between the opening and the liquid crystal display panel on an upper substrate with a same process for forming the gate bus line, as claimed in claim 3.

To wit, the present invention prevents the seal material from getting up to the liquid crystal display area due to a low water-permeability of the seal material against the metal film formed between the opening for injecting liquid crystal and the liquid crystal display area on the substrate, thus not causing display errors. Besides, since the metal film is very thin, it doesn't interfere with the injection of liquid crystal. In addition, since the metal film is made of the same material with the electrode and the wiring that form the liquid crystal display panel, it is possible to form the metal film with the same process for forming the electrode and the wiring, thus not increasing the number of processes of manufacturing the liquid crystal display panel.

[Embodiment of the Invention]

Hereinafter, a preferred embodiment of the present invention will be described. As shown in Fig. 1A and Fig. 1B, a sectional enlarged view of an opening 3 in Fig. 1A, a liquid crystal display panel 10 of the present invention

includes a metal film 8 formed on a surface of a substrate 12 between an opening 3 and a liquid crystal display area 8. As a material for the metal film 9, it is desired to apply an identical material used in the process for forming electrode or wiring so as not to increase the number of processes for manufacturing the liquid crystal display panel. In case of the liquid crystal display panel using TFT, for example, they include aluminum Al, titanium Ti, chromium Cr, silicon Si, etc. When the viscosity of the seal material 7 and the dimension of the opening 3 are fixed, the invasion velocity of the seal material 7 into the liquid crystal display panel 10 becomes slower in case of the metal film compared with that of the glass.

On the surface of the substrate adjacent to the opening 3 of the conventional liquid crystal display panel, the glass is being exposed and, accordingly, the seal material 7 gets quickly into the opening 3, thus decreasing permitted limits for the viscosity of the seal material 7 and the dimension of the opening 3. In the past, in case of glass, the invasion velocity of the seal material 7 is about 200㎛/min and the design standard value for an invasion distance A from the opening 3 is set to about 700㎛. However, if the invasion velocity has a deviation of about 30% due to the viscosity of the seal material 7 or the un-uniformity of the opening's width, the invasion distance is deviated about 210㎛ and the maximum invasion distance becomes 910㎛.

Meanwhile, the metal film 9 of the present invention has an invasion velocity of about 50μm/min. In is noted that the velocity varies in connection with water-permeabilities between the glass, the metal film and the seal material. In case that the metal film 9 is established having a width C of 150μm from an inward distance B of 650μm from the opening 3, the maximum invasion distance becomes about 750μm even the invasion velocity of the seal material has a deviation of about 30%, and the seal material gets up to the vicinity of 700μm, the design standard value, as shown in Fig. 1B. To this end, the seal material 7 cannot get up to the display area 8 of the liquid crystal display panel 10, thus preventing display errors. Since the invasion velocity becomes slow in case of the metal film 9, while the seal material 7 gets quickly in case of the exposed glass, it is possible to design the invasion distance of the seal material 7 precisely by modifying the dimension and the location of the metal film 9, i.e., the distance B and the width C in Fig. 1B. Besides, while the preferred embodiment thus far described establishes the metal film 9 on the substrate 12, the metal film 9 may be formed on the substrate 11 or on both substrates 11 and 12.

Hereinafter, description will be made citing an example that executes the formation of the metal film of the invention with the same process for manufacturing gate electrode, gate bus line of the TFT substrate (hereinafter, referred to as gate process) with reference to Fig. 2 illustrating processes for manufacturing liquid

crystal display panel in accordance with the preferred embodiment of the present invention.

First, in step 1 S1, the substrate is washed off to exclude dust, alkalinity, etc. In step 2 S2, aluminum film is formed having a thickness of about 1000Å, the same thickness with the gate electrode and the gate bus line, in the preferred embodiment of the invention, while the metal film to be the gate film is made by spattering or plasma CVD in the conventional process. In step 3 S3, resist responsive to ultraviolet rays is spread by spin coating. In step 4 S4, ultraviolet exposure is executed through an exposure mask 6. Here, since the exposure mask 6 includes a pattern for establishing the metal film of the invention in vicinity of the opening 3 for injecting liquid crystal besides the gate electrode and the gate bus line, they are all exposed at the same time. In step 5 S5, the resist irradiated by ultraviolet is removed by soaking in developing solution. In step 6 S6, the aluminum film, not coated by the resist, is removed by soaking in etching solution. Next, in step 7 S7, remaining resist is exfoliated by resist exfoliation material and washed off. Finally, in step 8 S8, it is detected whether desired gate electrode, gate bus line, metal line, etc., are obtained.

In the preferred embodiment of the invention, a rectangular pattern having a width of 150μm in a short direction and a width 15mm in a long direction is formed

as the metal film 9 on the distance B of 650μm from an edge of the glass substrate of the opening 3.

Hereby, while the gate process of TFT substrate is ended, gate insulating film, TFT, drain electrode, drain bus line, pixel electrode, alignment film, etc., are further established on the TFT substrate in accordance with a well-known method of manufacturing TFT substrate. Meanwhile, on the CF substrate opposite to the TFT substrate, black matrix, color filter, common electrode, alignment film, etc., are mounted. Then, the adhesive agent such as epoxy resin is applied and spacers are distributed on the CF substrate. Besides, when applying the adhesive agent 2, the opening 3 for injecting liquid crystal is opened 20mm to inject the liquid crystal. After injecting the liquid crystal, ultraviolet hardening seal material 7 (30 Y-228 produced by ThreeBond Inc.) is applied. Then, after 250 seconds, ultraviolet rays are irradiated to harden the seal material 7. In result, the flow of the seal material 7 gets into the vicinity of the design standard value of 700μm. To this end, the seal material 7 does not intrude into the display area 8 of the liquid crystal display panel, thus preventing display errors.

[Effect of the Invention]

As described above, the present invention prevents the seal material from getting up to the liquid crystal display area when sealing the openings after injecting

the liquid crystal, thus solving the problem that causes display errors. Besides, the present invention enhances the display quality of the liquid crystal display panel, not increasing the number of processes of manufacturing the liquid crystal display panel.

[Description of Drawings]

Fig. 1A is a plane view showing a liquid crystal display panel and Fig. 1B is a sectional enlarged view of an opening in Fig. 1A in accordance with a preferred embodiment of the present invention;

Fig. 2 is a flowchart illustrating processes for manufacturing liquid crystal display panel in accordance with a preferred embodiment of the present invention;

Fig. 3 is a sectional enlarged view illustrating problems of the conventional liquid crystal display panel; and

Figs. 4A and 4B are plane views depicting the convention liquid crystal display panel.